

FIG. 1

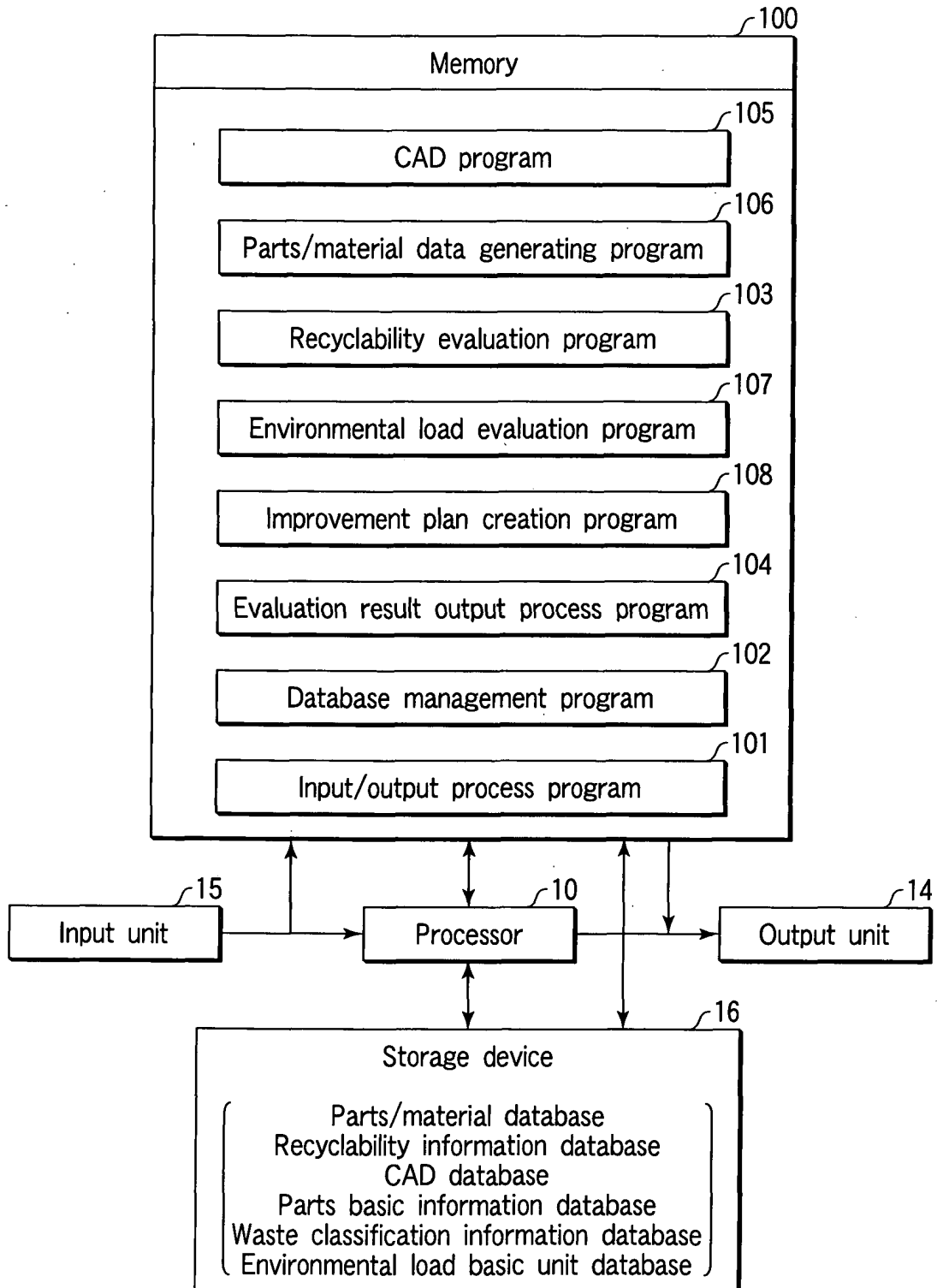


FIG. 2

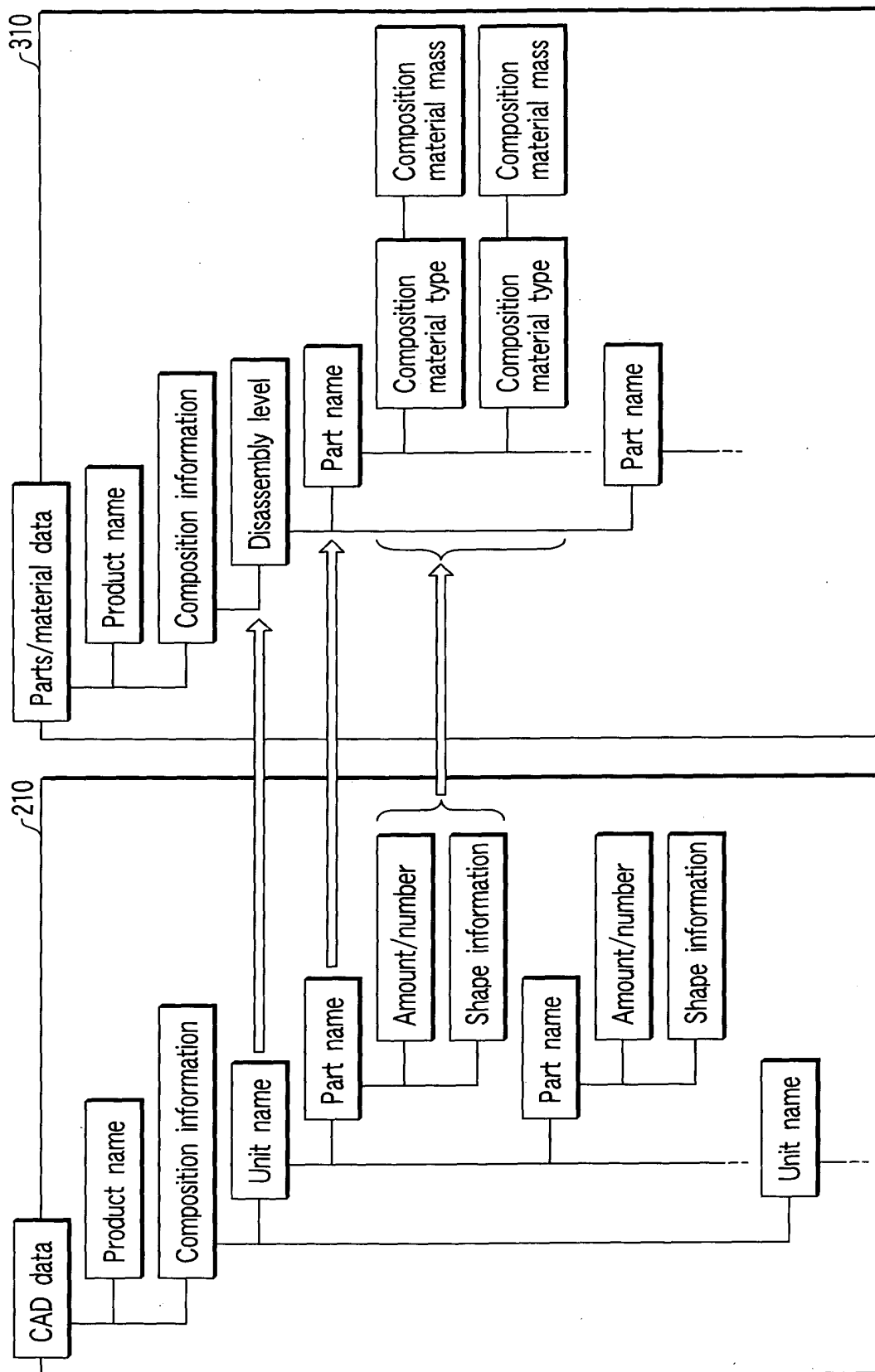


FIG. 3

R1

Product name

Unit A

Unit AA

Part A

Part B

Unit AB

Part A

Part D

Unit B

Product name

Product dimensions (m)

Depth

Width

Height

CAD data

Unit name

Part A

Amount/number

Shape

Input data

Unit name

Part A

Part name

Material name

Mass

Material name

Mass

Correct

End

FIG. 4

Parts basic information database

Part name	Composition material			
		Material type	Mass (g)	Density (g/m ³)
Part A	Metal	Metal (1-1-2)	250	
		Metal (1-1-3)	20	
Part B	Metal	Metal (2-2-1)		10
		Metal (2-2-2)		20

FIG. 5

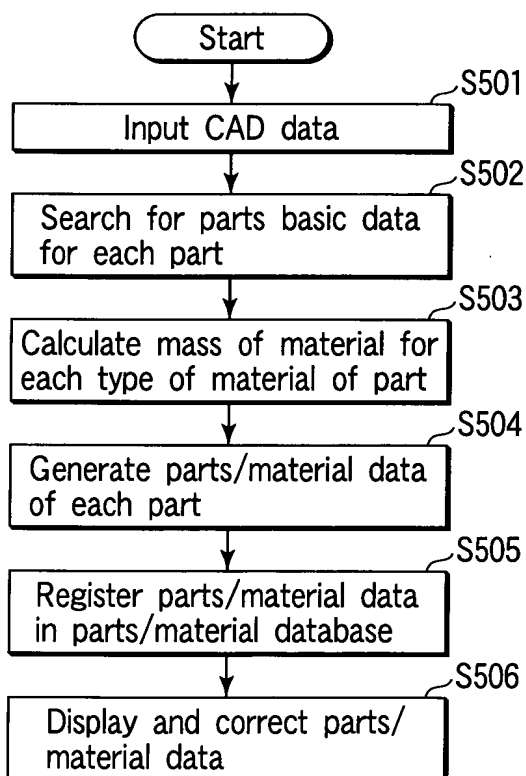


FIG. 6

Parts/material database

Product name : Product 1

Disassembly level						Raw material classification/g			
First disassembled part		Second disassembled part		Third disassembled part		Metal			
Article name	Weight /g	Article name	Weight /g	Article name	Weight /g	Metal 1	Metal 2	Metal 3	Metal 4
Part (1)	2780	Part (1-1)	380	Part (1-1-1)	100		60	40	
				Part (1-1-2)	250	250			
				Part (1-1-3)	30	20			
		Part (1-2)	700	Part (1-2-1)	400				
				Part (1-2-2)	200				10
				Part (1-2-3)	50		50		
				Part (1-2-4)	50		50		
		Part (1-3)	1700	Part (1-3-1)	1500				
				Part (1-3-2)	200				
Part (2)	2300	Part (2-1)	2000		2000				
		Part (2-2)	300	Part (2-2-1)	200		200		
				Part (2-2-2)	100	20		10	
Part (3)	300	Part (3-1)	100		100				
		Part (3-2)	200		200		200		
Total	5380		5380		5380	290	560	50	10

FIG. 7A

Plastic				Others							
Resin 1	Resin 2	Resin 3	Resin 4	Glass 1	Glass 2	Glass 3	Paper 1	Paper 2	Wood	Fiber	Fats
10											
400											
	190										
	1480	10					10				
			200								
1200	800										
				70							
											100
1610	2470	10	200	70	0	0	10	0	0	0	100

FIG. 7B

Basic procedure of recyclability evaluation

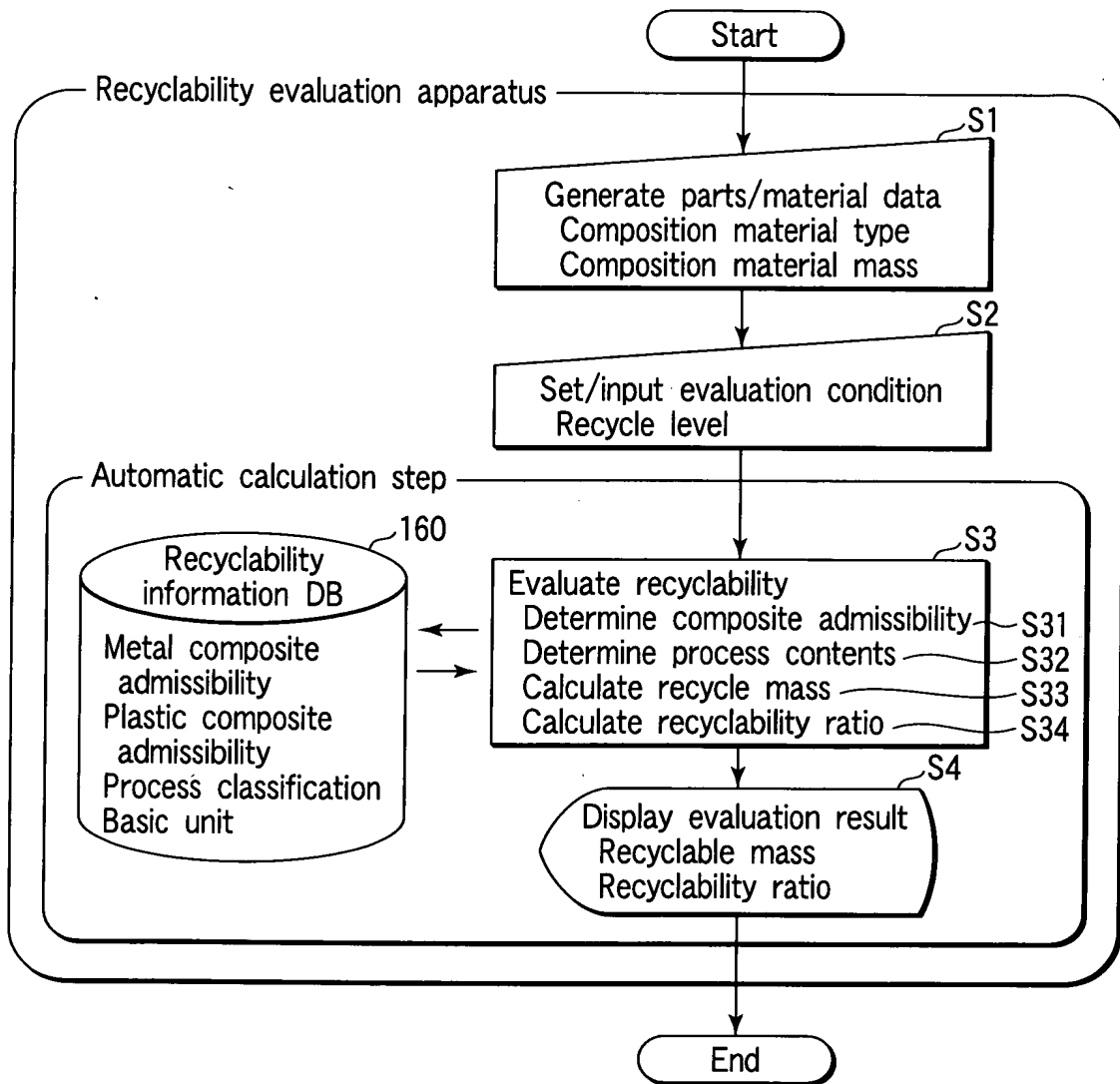


FIG. 8

Example of recyclability
valuation procedure

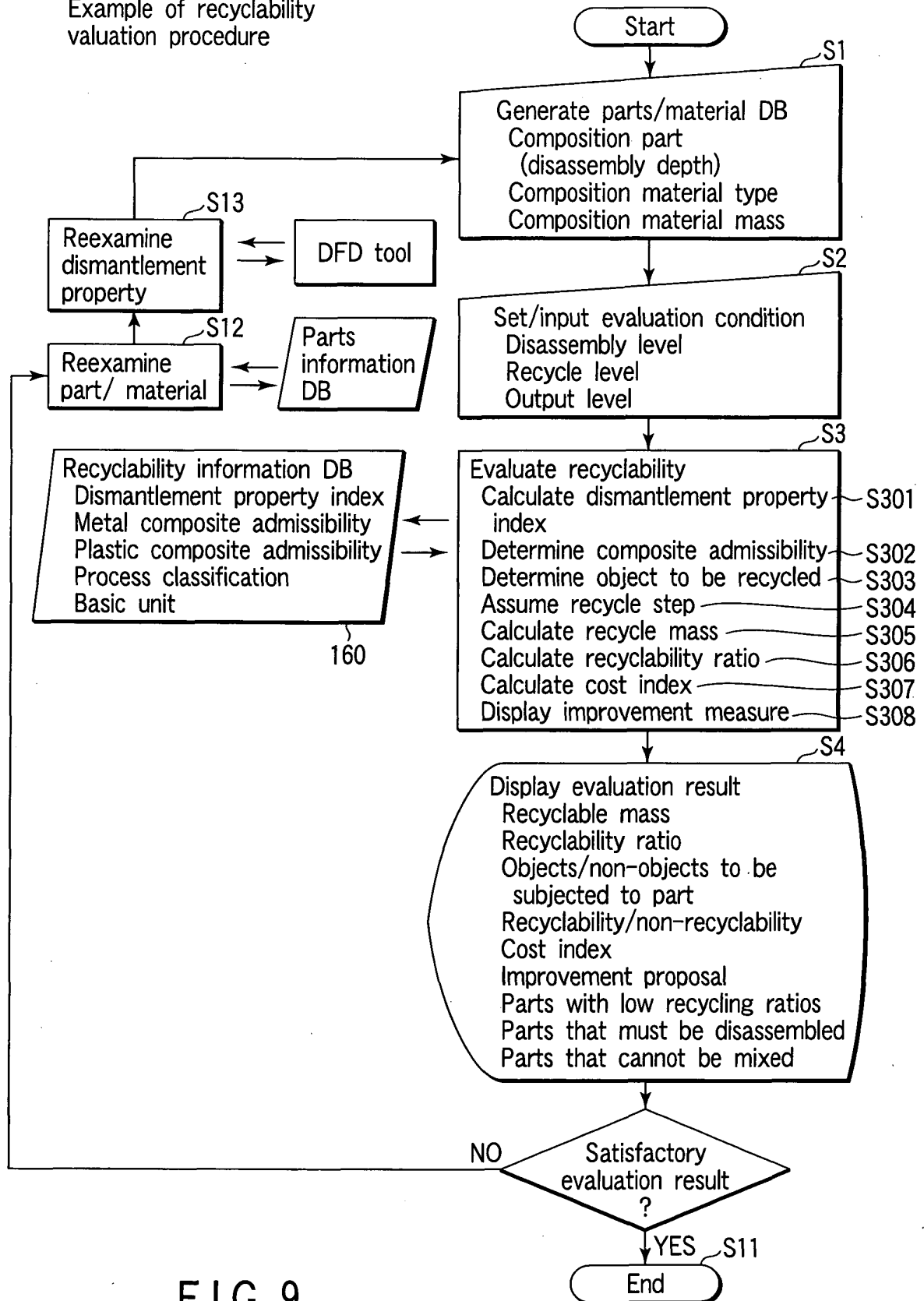


FIG. 9

Discard/recycling contents
determination procedure

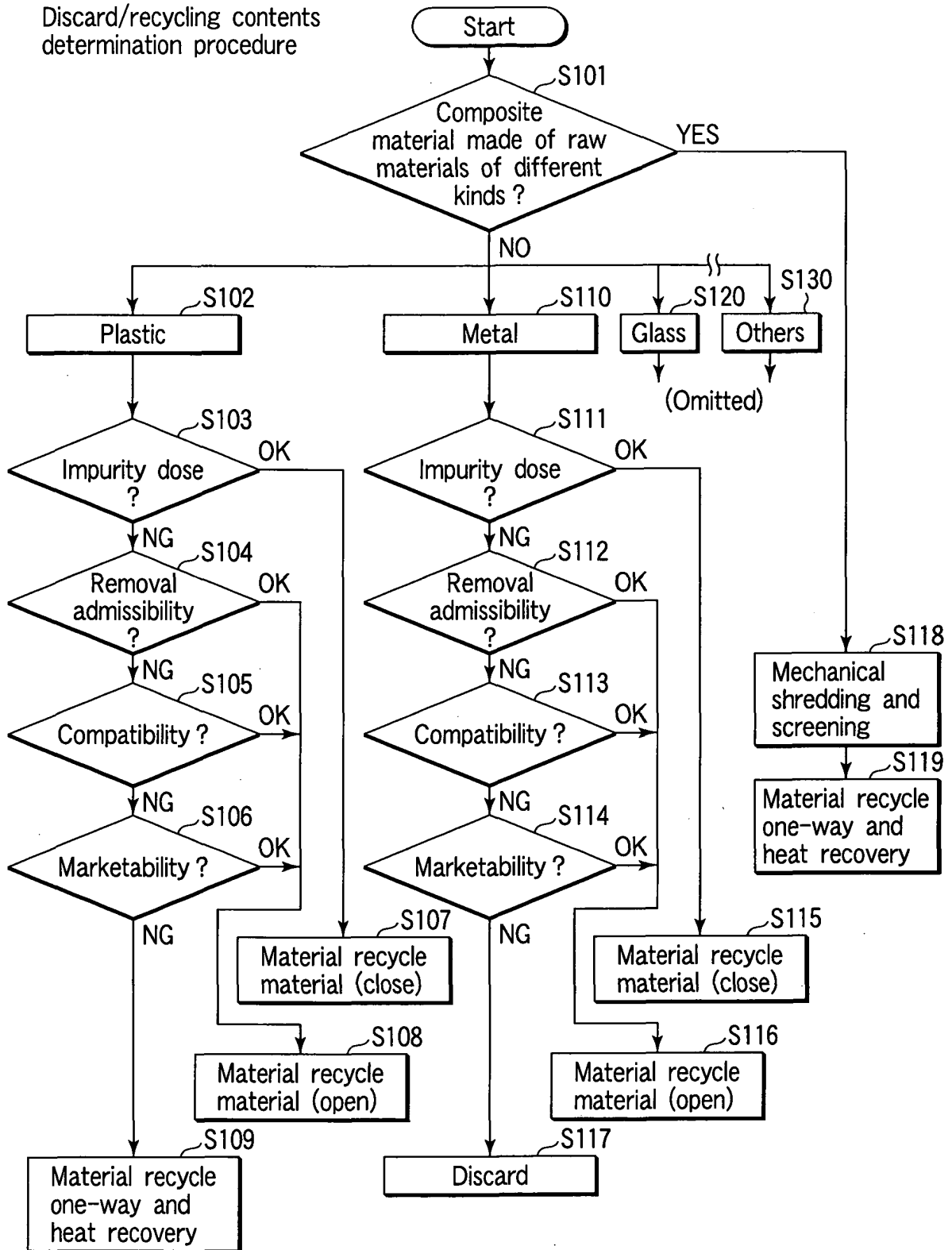


FIG. 10

Impurity permissible dose of plastic
~Impurity content~

		Second component											
		Resin 1	Resin 2	Resin 3	Resin 4	Resin 5	Resin 6	Resin 7	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12
First component	Resin 1		1.0	2.0	2.0	2.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
	Resin 2	1.0		2.0	2.0	2.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
	Resin 3	1.0	1.0		2.0	2.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
	Resin 4	1.0	1.0	2.0		2.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
	Resin 5	1.0	1.0	2.0	2.0		0.5	1.0	1.0	0.5	1.0	1.0	1.0
	Resin 6	1.0	1.0	2.0	2.0	2.0		1.0	1.0	0.5	1.0	1.0	1.0
	Resin 7	1.0	1.0	2.0	2.0	2.0	0.5		1.0	0.5	1.0	1.0	1.0
	Resin 8	1.0	1.0	2.0	2.0	2.0	0.5	1.0		0.5	1.0	1.0	1.0
	Resin 9	1.0	1.0	2.0	2.0	2.0	0.5	1.0	1.0		1.0	1.0	1.0
	Resin 10	1.0	1.0	2.0	2.0	2.0	0.5	1.0	1.0	0.5		1.0	1.0
	Resin 11	1.0	1.0	2.0	2.0	2.0	0.5	1.0	1.0	0.5	1.0		1.0
	Resin 12	1.0	1.0	2.0	2.0	2.0	0.5	1.0	1.0	0.5	1.0	1.0	

(Note) (second component weight/first component weight) × 100 [unit : %]

FIG.11

Removal admissibility of plastic composite
~Discrimination/separation technique~

		Second component											
		Resin 1	Resin 2	Resin 3	Resin 4	Resin 5	Resin 6	Resin 7	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12
First component	Resin 1		X	X	X	X	○	X	△	○	X	X	X
	Resin 2	X		X	X	○	○	X	△	○	X	X	X
	Resin 3	X	X		X	○	○	X	△	○	X	X	X
	Resin 4	X	X	X		○	○	X	△	○	X	X	X
	Resin 5	X	X	X	X		○	△	△	○	X	X	X
	Resin 6	○	○	○	○			○	○	X	○	○	○
	Resin 7	X	X	X	X	○	○		△	○	X	X	X
	Resin 8	△	△	△	△	△	○			○	△	△	△
	Resin 9	○	○	○	○	○	X	○	○		○	○	○
	Resin 10	X	X	X	X	X	○	X	△			X	X
	Resin 11	X	X	X	X	X	○	X	△	○	X		X
	Resin 12	X	X	X	X	X	○	X	△	○	X	X	

(Note) ○ : Automatic screening technique is available
△ : Automatic screening technique is available, and screening technique depends on shape etc
X : Screening is difficult

FIG. 12

Compatibility of plastic
~Compatible polymer blend and polymer alloy using compatibiliser~

		Second component											
		Resin 1	Resin 2	Resin 3	Resin 4	Resin 5	Resin 6	Resin 7	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12
First component	Resin 1		s	c	n	c	c	c	c	c	c	n	c
	Resin 2	s		n	n	c	c	c	c	c	c	c	c
	Resin 3	c	n		s, c	n	s	s	n	c	n	s, c	n
	Resin 4	n	n	s, c		n	c	c	n	c	c	c	c
	Resin 5	c	c	n	n		n	s	n	n	c	n	c
	Resin 6	c	c	s	c	n		c	n	c	c	n	c
	Resin 7	c	c	c	c	s	c		c	c	n	c	c
	Resin 8	c	c	n	n	n	n	c		n	n	n	n
	Resin 9	c	c	c	c	n	c	c	n		c	s	n
	Resin 10	c	c	n	c	c	c	n	n			s	n
	Resin 11	n	c	s, c	c	n	n	c	n	s	s		c
	Resin 12	c	c	n	c	c	c	c	n	n	n	c	

(Note) s : Compatible polymer blend
c : Incompatible polymer blend with precedent of alloy using compatibiliser
n : No compatibility information

FIG. 13

Marketability of plastic composite
~Commercially available polymer blend~

		Second component											
		Resin 1	Resin 2	Resin 3	Resin 4	Resin 5	Resin 6	Resin 7	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12
First component	Resin 1	△	△	○	X	△	○	X	X	X	○	X	○
	Resin 2	△	△	X	△	X	X	△	X	X	X	X	○
	Resin 3	○	X	△	△	X	○	△	X	○	X	○	X
	Resin 4	X	△	△	△	X	X	△	X	○	△	X	X
	Resin 5	△	X	X	X	△	○	○	X	○	○	○	X
	Resin 6	○	X	○	X	○	△	○	X	X	○	○	○
	Resin 7	X	△	△	△	○	○	△	○	○	X	○	○
	Resin 8	X	X	X	X	X	X	○	△	X	X	X	X
	Resin 9	X	X	○	X	○	X	○	X	△	△	○	X
	Resin 10	○	X	X	△	○	○	X	X	△	△	○	X
	Resin 11	X	X	○	X	○	○	○	X	○	○	△	X
	Resin 12	○	○	X	X	X	○	○	X	X	X	X	△

(Note) ○ : Commercially available blend composite
△ : Combination with expected marketability
X : Combination with low marketability

FIG. 14

Plastic composite admissibility for material recycle

	Second component											
	Resin 1	Resin 2	Resin 3	Resin 4	Resin 5	Resin 6	Resin 7	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12
First component	Resin 1	A	A	B	B	A	B	B	B	A	D	A
	Resin 2	A	D	C	B	B	B	D	B	B	B	A
	Resin 3	A	D	A	D	A	B	D	A	D	A	D
	Resin 4	B	C	D	D	B	B	D	B	B	B	B
	Resin 5	B	B	D	A	A	A	D	A	A	A	B
	Resin 6	A	B	A	A	A	A	D	B	A	A	A
	Resin 7	B	B	B	A	A	B	B	B	D	B	B
	Resin 8	B	D	D	D	D	B	D	D	D	D	D
	Resin 9	B	B	A	A	B	B	D	B	B	A	D
	Resin 10	A	B	D	A	A	D	D	B	A	A	D
	Resin 11	D	B	A	A	A	B	D	A	A	A	B
	Resin 12	A	A	D	B	A	B	D	D	D	B	B

Explanatory note	Evaluation	Details	Classification
	A	Potential demand of recycled article is present	Compatible polymer blend and commercially available polymer blend
	B	Composite admissibility may be present if new application purpose for recycled material is found	Incompatible polymer blend with precedent of alloy using compatibiliser
	C	Composite admissibility may be present upon technology development in future	Although marketability is expected, no precedent of alloy is present
	D	Separating is recommended, and dismantlement property needs to be increased	No marketability, no compatibility, and no precedent of alloy are present

FIG. 15

Metal composite admissibility for material recycle

	Second component											
	Resin 1	Resin 2	Resin 3	Resin 4	Resin 5	Resin 6	Resin 7	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12
First component	Resin 1	C	D	A	A	B	B	B	B	C	B	B
	Resin 2	A	A	A	A	A	C	A	D	A	D	D
	Resin 3	C	C	C	C	D	D	D	D	C	D	D
	Resin 4	A	A	B	B	D	D	D	D	D	D	B
	Resin 5	D	A	D	D	D	D	D	D	A	A	A
	Resin 6	B	D	D	D	D	D	D	D	D	D	D
	Resin 7	B	D	D	D	D	D	D	D	D	D	D
	Resin 8	B	D	D	D	D	D	D	D	D	D	D
	Resin 9	B	D	D	D	D	D	D	D	D	D	D
	Resin 10	A	A	D	D	D	A	A	D	D	D	D
	Resin 11	D	D	D	D	D	D	D	D	D	D	D
	Resin 12	C	C	A	D	C	C	D	D	D	D	D

Explanatory note	Evaluation	Details	Classification
A		Potential demand of recycled article is present	Separation by refining is possible, or application purpose for alloy is present
B		Composite admissibility may be present if new application purpose for recycled material is found	Separate by refining is difficult, and degree of accumulation (degree of urgent measure) is low
C		Separating is recommended, and dismantlement property needs to be increased	Although marketability is expected, no precedent of alloy is present
D		Separating is recommended, and dismantlement property needs to be increased	No data

FIG. 16

Discard/recycling process classification/basic unit database

Process classification		Recyclability evaluation basic unit			Environmental load evaluation basic unit			
		Collection yield	Process reduction ratio***	Energy	CO2	NOx***
Material recycle	Material recycle	***	***	***	***	***	***	***
		***	***	***	***	***	***	***
		***	***	***	***	***	***	***
	Open recycle (for another application purpose, cascade)	***	***	***	***	***	***	***
One-way recycle	Blast furnace reducing material	***	***	***	***	***	***	***
	Solid fuel generation	***	***	***	***	***	***	***
	Liquefaction fuel generation	***	***	***	***	***	***	***
Heat recovery	Incineration with power generation	***	***	***	***	***	***	***
	Incineration with heat utilization	***	***	***	***	***	***	***
Discard	Simple incineration	***	***	***	***	***	***	***
	Simple landfill	***	***	***	***	***	***	***

FIG.17

Distribution ratio

Classification rank				Recycle amount Collection amount
1	2	3	4	%
Waste in Japan				***
	Industrial waste			***
		Dehydration process		***
			Sludge	***
			Animal excrement	***
			Waste acid	***
			Animal and vegetable residue	***
			Waste alkali	***
		Incineration process		***
			Building rubble	***
			Wood waste	***
			Waste plastics	***
			Waste oil	***
			Wastepaper	***
			Waste rubber	***
			Carcass	***
			Waste fiber	***
		Shredding process		***
			Slag	***
			Smoke and dust	***
			Waste metal	***
			Waste glass and waste pottery	***
			Combustion residue	***
	Municipal waste			***
		Urban garbage		***
			Combustible	***
			Incombustible	***
			Large-sized	***
		Business garbage		***
			Combustible	***
			Incombustible	***
			Large-sized	***

FIG. 18A

[illegible]

FIG. 18B

Procedure of environmental load
evaluation in discard step

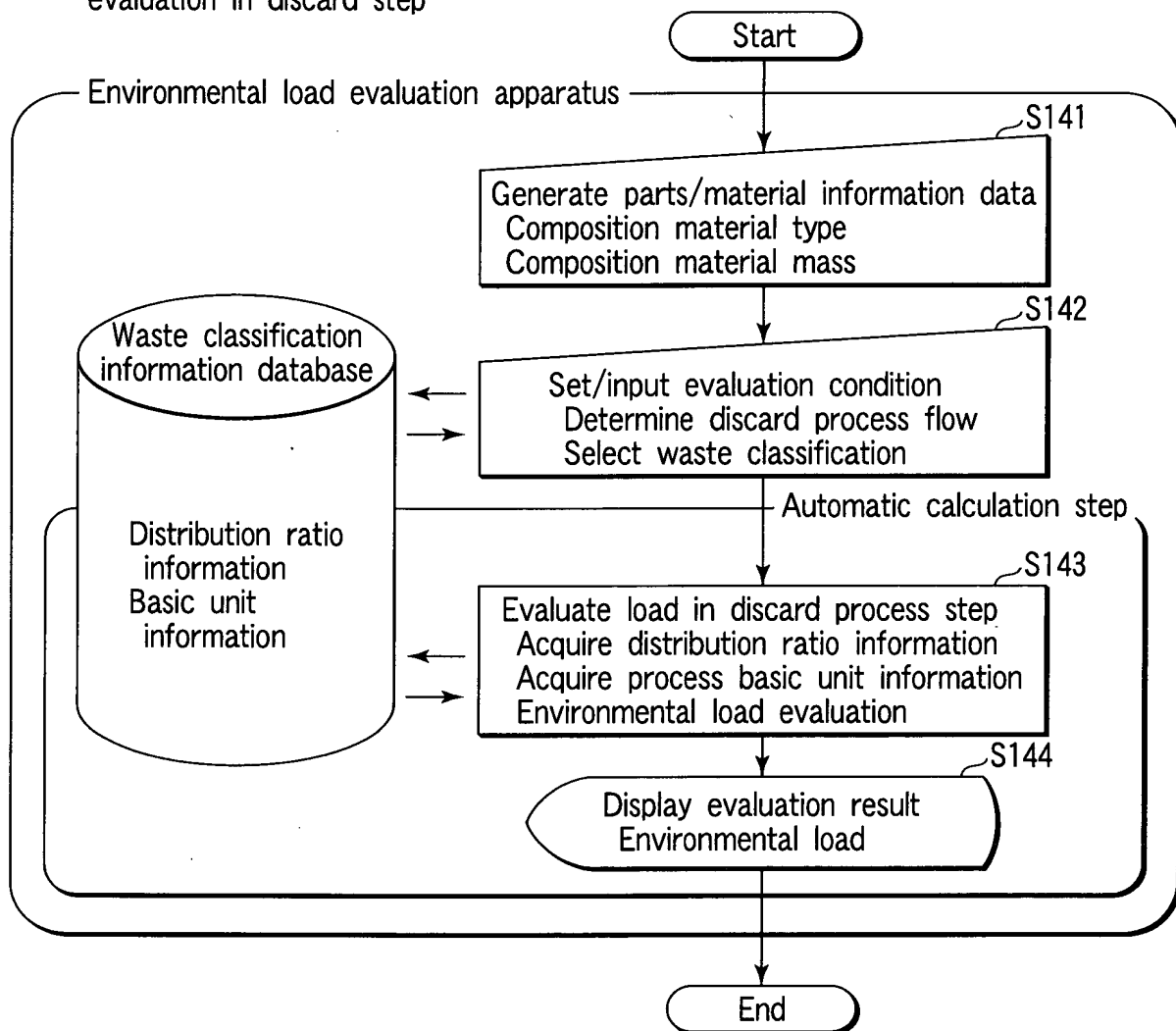


FIG. 19

Result output window

Recycle output condition setting

Recycle range

☒ Reuse
☒ Material (for same application purpose)
☒ Material (cascade)
☐ Chemical
 (generation of chemical raw material)
☐ Blast furnace reducing material/
 coking raw material
☐ Chemical (fuel generation)
☐ Solid fuel generation (RDF/RPF)
☐ Heat recovery
 (power generation/heat utilization)

Sales price

☒ Only collection for pay
☐ Pay/reverse charge is not taken
 into consideration

Product recyclability evaluation result

Product name

Model

Sample

Remark

Product A

—

Trial calculation
case 2

Copper/iron parts
disassembly

Recyclable mass

Discard mass

Recyclability ratio

Discard/recycle cost

950 g

50 g

95 %

-50 Yen/piece

Comparison data

Product A

—

Trial calculation
case 1

Product that is
not disassembled

0

1000

0

40

OK

→

Display unit

Display process method unit

Main menu

FIG. 20

Result output window

Recycle output condition setting

Recycle range

☒ Reuse
☒ Material (for same application purpose)
☒ Material (cascade)
☐ Chemical (generation of chemical raw material)
☐ Blast furnace reducing material/coking raw material
☐ Chemical (fuel generation)
☐ Solid fuel generation (RDF/RPF)
☐ Heat recovery (power generation/heat utilization)

☐ Only collection for pay
☒ Pay/reverse charge is not taken into consideration

Product recyclability evaluation result

Product name

Model

Sample

Remark

Product B

—

Trial calculation case 2

Parts are disassembled (two parts)

Recyclable mass

Discard mass

Recyclability ratio

Discard/recycle cost

400 g

600 g

40 %

20 Yen/piece

OK

→

Comparison data

Product B

—

Trial calculation case 1

Product that is not disassembled

0

1000

0

40

Display unit

Display process method unit

Main menu

FIG. 21

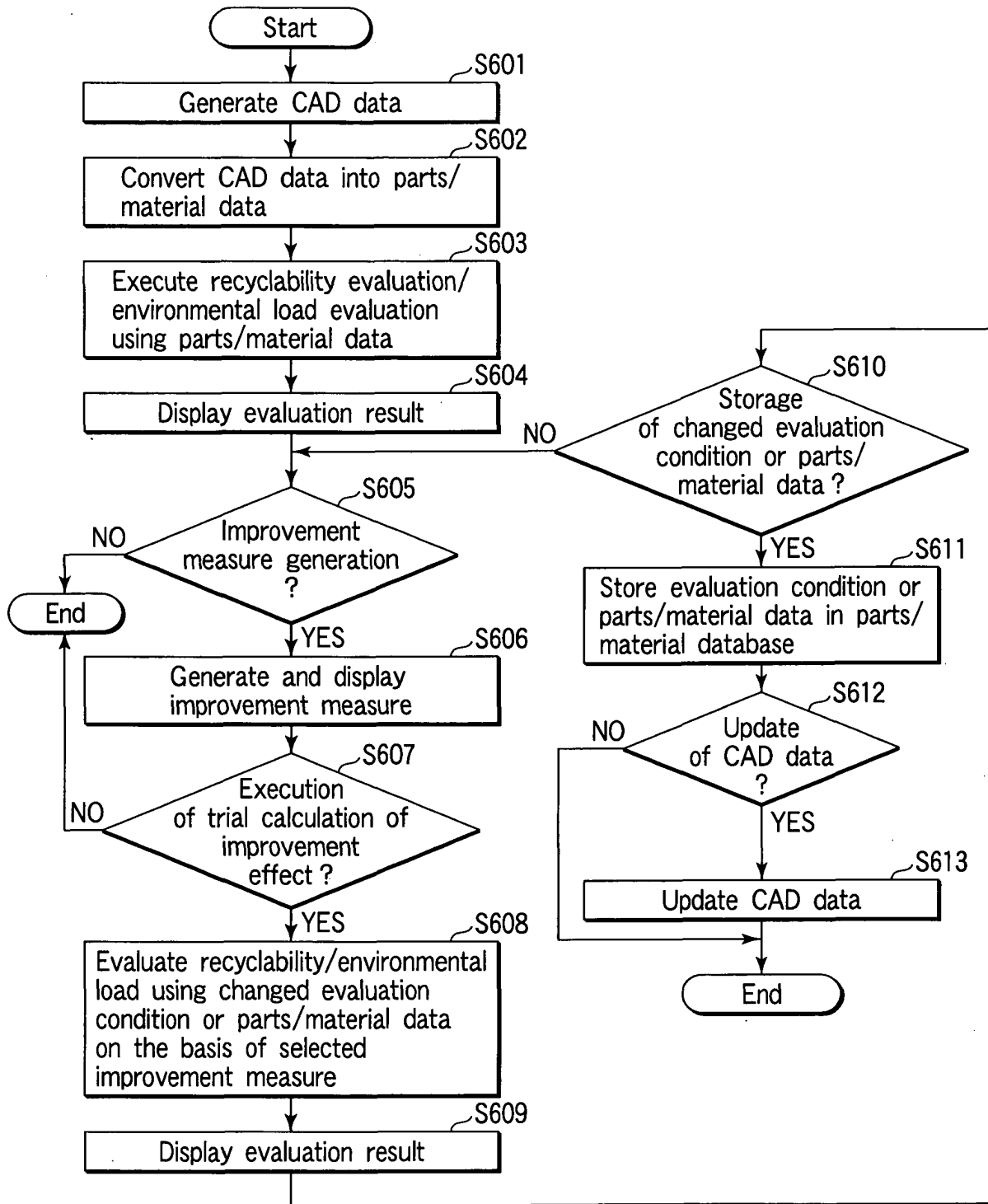


FIG. 22

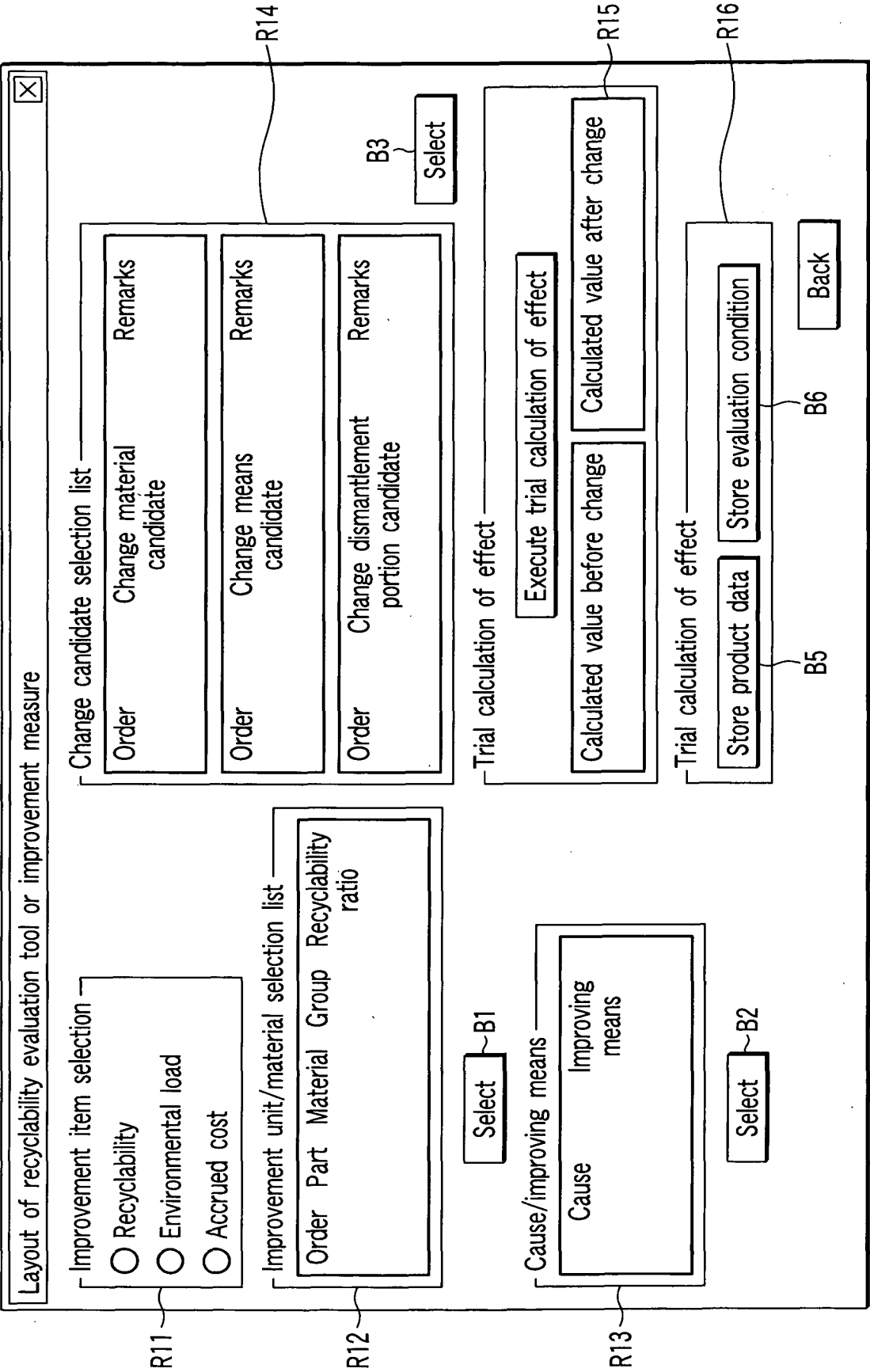


FIG. 23

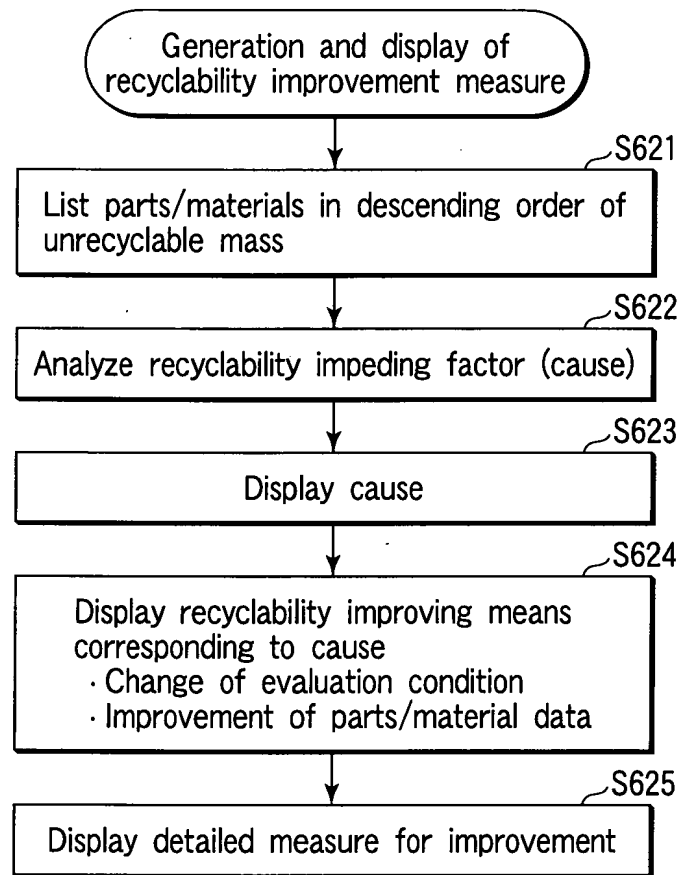


FIG. 24

Cause check item	Cause	Change of evaluation condition	Improvement of parts/material data	
			Cause check item	Cause check item
A1 Is part/material unrecyclable ?	Part/material is unrecyclable	Register part/material as recyclable part/material	Change part/material to recyclable part/material	Display parts/materials which are recyclable and have same function as that of part/material as change candidates
	Recyclability is unknown because material information is unknown	Input more detailed material information		Display standard basic information of part/material
A2 Is raw material classification "others" ?	No recycle method that can be applied to part/material is present	Newly register recycle method that can be applied to material		Display recycle methods that can be applied to part/material as change candidates
	Collectable materials and recyclability ratio are limited for part/material containing plurality of raw materials	Make raw materials of different kinds dismantlable and set another part/material		Display portions at which part/material dismantles
A3 Does part/material contain plurality of raw materials ?			Change part/material to single raw material	Display raw material compositions in part/material in descending order of mass

FIG. 25

Cause check item	Cause	Change of evaluation condition	Improvement of parts/material data	
			Cause check item	Cause check item
Does the part/material contain plurality of materials?	It is determined as unrecyclable for part/material containing plurality of materials having no composite admissibility	Make part/material dismantlable for each material type to register plurality of parts/materials		Display portions at which part/material dismantles
			Change part/material to part/material containing single material	Display material compositions in part/material in descending order of mass
			Change material having no composite admissibility to material with composite admissibility	Display materials with composite admissibility with another material as change candidates

FIG. 26

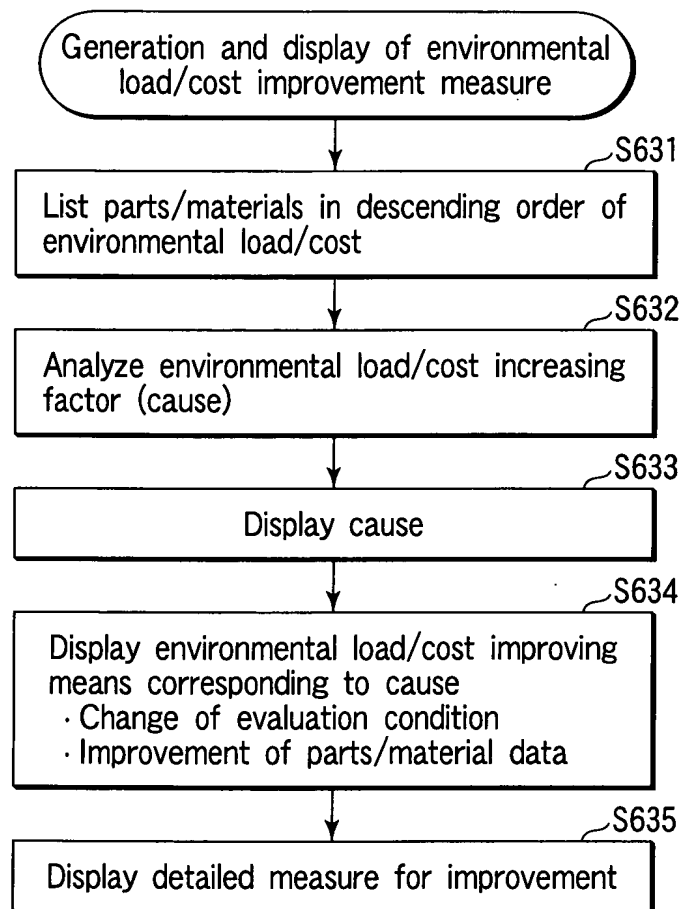


FIG. 27

Cause check item	Cause	Change of evaluation condition	Parts/material data improving means	Support to lay out detailed improvement measure
Is step having high environmental load (cost) recycling process step ?	Recycling process with high environmental load (cost) is executed	Select process with low environmental load (cost) from selectable recycling processes		Display recycling methods that can be applied to part/material as change candidates in ascending order of environmental load (cost)
			Change part/material to part/material to which process with low environmental load (cost) can be applied	Display parts/materials having same function as that of part/material as change candidates in ascending order of environmental load (cost) of recycling method that can be applied to parts/materials
				Display portions at which part/material dismantles as text data or image data

B1

FIG.28

Cause check item	Cause	Change of evaluation condition	Parts/material data improving means	Support to lay out detailed improvement measure
Is step having high environmental load (cost) transport step ?	Transport with high environmental load (cost) is executed	Select means with low environmental load (cost) from selectable transport means		Display transport means that can be applied to part/material as change candidates in ascending order of environmental load (cost)
			Change part/material to part/material to which transport means with low environmental load (cost) can be applied	Display parts/materials having same function as that of part/material as change candidates in ascending order of environmental load (cost) of transport means that can be applied to parts/materials
			Change part/material which can be transported to transport destination with low environmental load (cost)	Display portions at which part/material dismantles as text data or image data Display parts/materials having same function as that of part/material in ascending order of environmental load for transport until transport destination

FIG. 29

Cause check item	Cause	Change of evaluation condition	Parts/material data improving means	Support to lay out detailed improvement measure
Is step having high environmental load (cost) dismantlement step ?	Dismantlement with high environmental load (cost) is executed	Select means with low environmental load (cost) from selectable dismantlement means		Display dismantlement means that can be applied to part/material as change candidates in ascending order of environmental load (cost)
			Change part/material to part/material to which dismantlement means with low environmental load (cost) can be applied	Display parts/materials having same function as that of part/material as change candidates in ascending order of environmental load (cost) of dismantlement means that can be applied to parts/materials
		Divide disassembly level		Display portions at which part/material dismantles as text data or image data
				Display portions at which part/material dismantles as change candidates in ascending order of environmental load (cost)

FIG. 30

First table

Part/ material name	Recyclability	Applicable recycling method	Environmental load/cost	Presence/absence of connection (joint) portion	Presence/absence of designation of transport means

FIG. 31

Second table

Part/ material name	Connection portion	Dismantle ability	Connection method	Dismantlement method	Environmental load/cost

FIG. 32

Third table

Part/ material name	Transport means	Environmental load/cost

FIG. 33

Fourth table

Function	Part/ material name

FIG. 34

Fifth table

Part name	Composition material			
		Material type	Mass (g)	Density (g/m ³)
Part A	Metal	Metal (1-1-2)	250	
		Metal (1-1-3)	20	
Part B	Metal	Metal (2-2-1)		10
		Metal (2-2-2)		20

FIG. 35

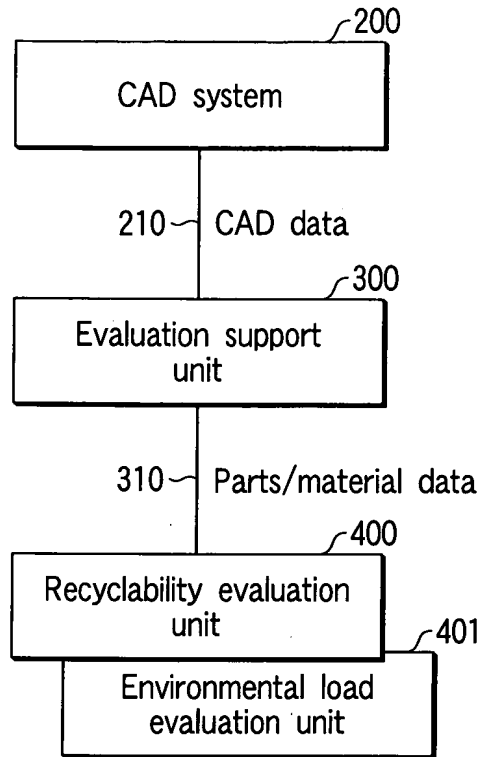


FIG. 36

Number	Recycle condition
1	No resin closed recycle, non-recycle part = part E
2	ABS for closed recycle, non-recycle part = part E
3	PS for closed recycle, non-recycle part = part E

FIG. 39

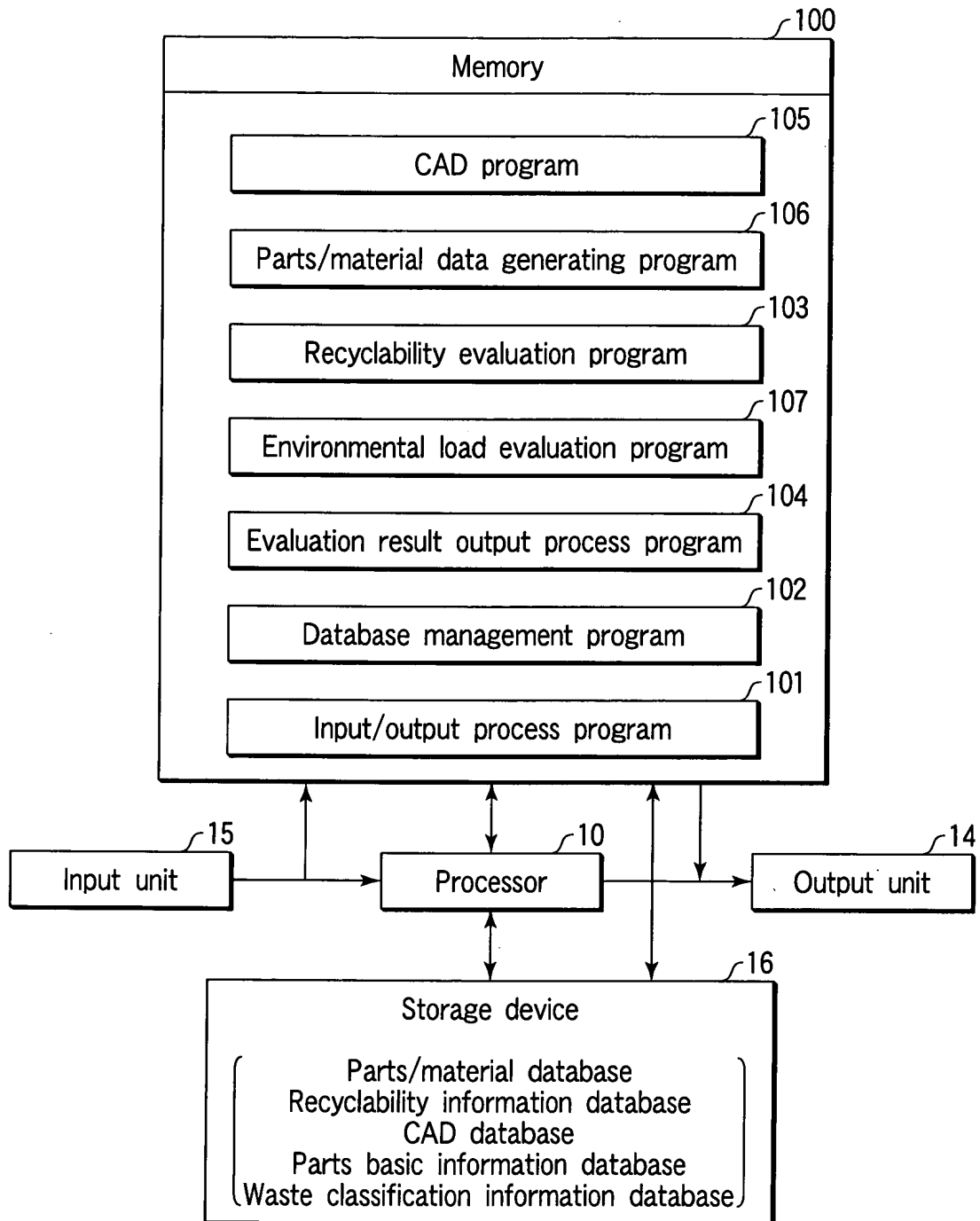


FIG. 37

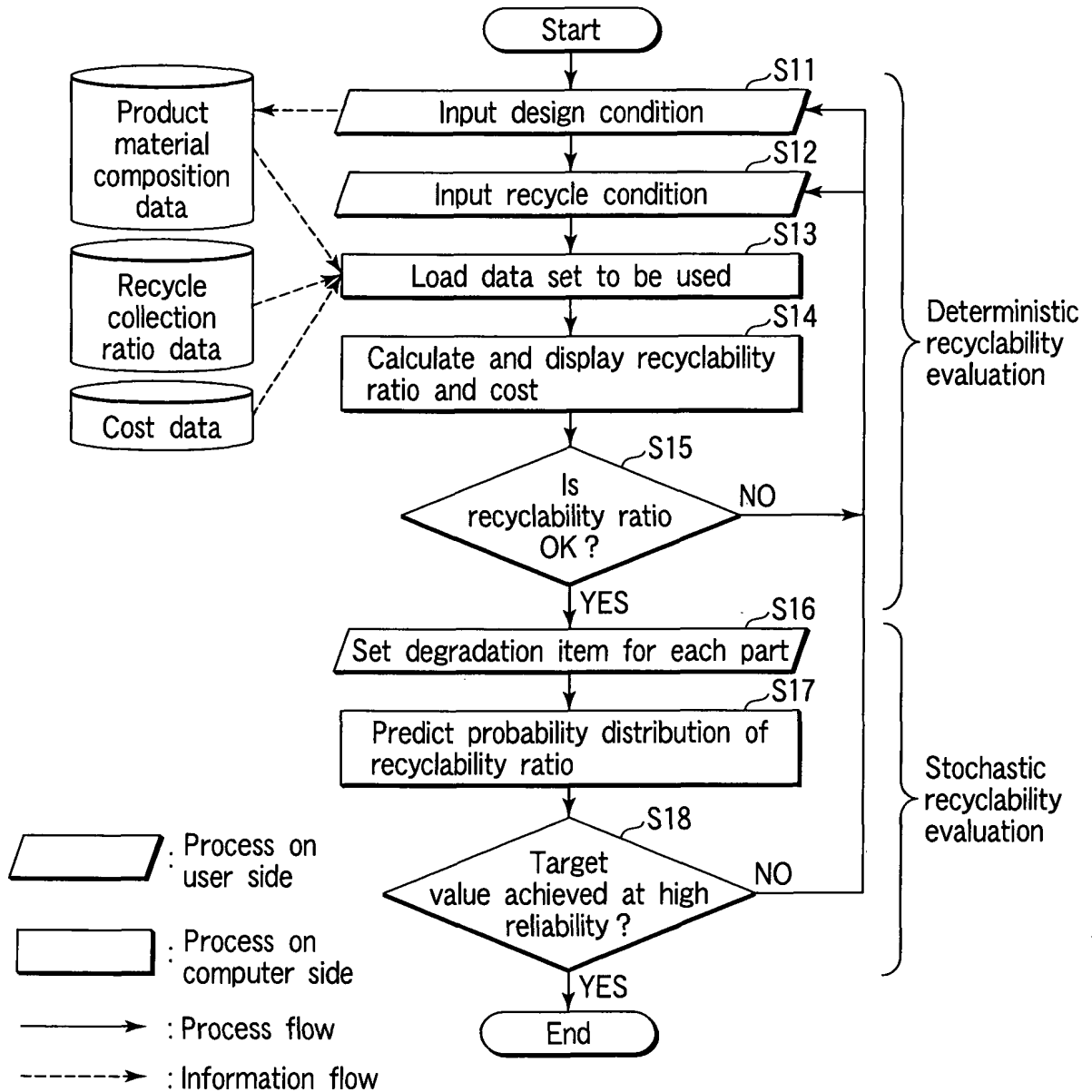


FIG. 38

Non-recycle part						1				
		Part A	Part B	Part C	Part D	Part E	Part F	Part G	Part H	
Material name	Mass [g]									
Steel	709	5	90		15		95	500	4	
Copper alloy	31		6				5	20		
Aluminum alloy	43		2					24	18	
Other metals	4								4	
	0									
Epoxy resin	32					30		2		
Polyethylene	0									
Polystyrene	0									
Forming polystyrene	0									
AS resin	0									
ABS resin	79				56		23			
Polypropylene	424	19		2	1	2	400			
Vinyl chloride resin	20						20			
Polycarbonate	0									
Other resin products	3			2	1					
Rubber	1						1			
Glass	0									
Corrugated fiberboard	0									
Paper	0									
Conductor	138		38				9	67	24	
Semiconductor	25					20			5	
Other electronic parts	10					10				
Others	2				0		2			
Total		1520	24	35	4	74	62	555	613	53

↓ Presence/absence resin closed recycle

↓ Presence/absence resin closed recycle

FIG. 40A

Recycle collection ratio [%]	Average collection unit price [yen/kg]	Average material unit price [yen/kg]
100%	-7	88
100%	-125	458
100%	-150	543
0%	0	723
0%	35	340
100%	42	397
100%	50	147
0%	78	197
100%	27	279
100%	23	217
100%	70	284
100%	25	141
100%	25	131
0%	35	458
0%	0	370
100%	-10	299
0%	0	57
0%	0	137
80%	-14	1,454
0%	0	53
0%	0	8,100
0%	0	

Intermediate process unit price [yen/kg]	27
Transport unit price [yen/kg]	46
Landfill unit price [yen/kg]	30

F I G. 40B

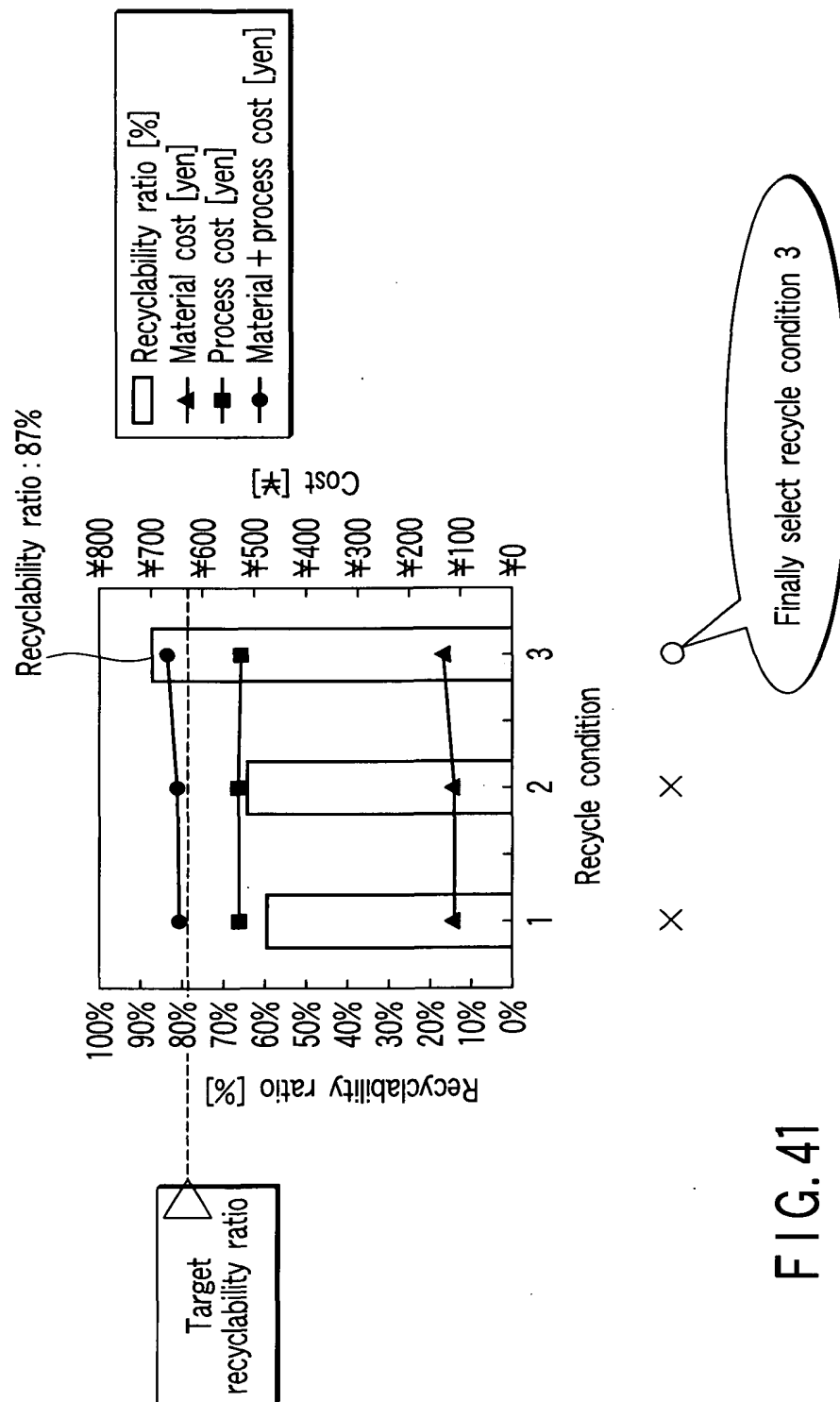


FIG. 41

Degradation factor	Thermal degradation									
	Chemical degradation		1		1				1	
	Photo-degradation	1	1	1	1	1	1	1	1	1
Part composition of product		Part A	Part B	Part C	Part D	Part E	Part F	Part G	Part H	

FIG. 42

Number of degradation factors applied	Part recycle collection amount			Probability distribution shape
	Minimum value	Maximum value		
0	= Maximum value	Mass of corresponding resin in each part		Uniform
1	= Maximum value * α	Mass of corresponding resin in each part		Uniform
2	= Maximum value * β	Mass of corresponding resin in each part		Uniform
3	= Maximum value * γ	Mass of corresponding resin in each part		Uniform

For $0 \leq \alpha, \beta, \gamma < 1$

FIG. 43

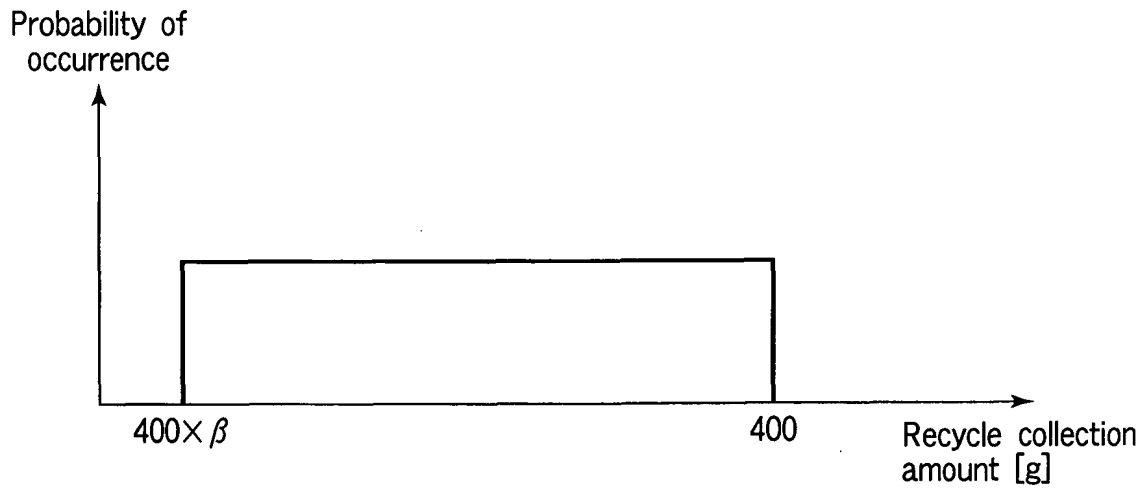


FIG. 44

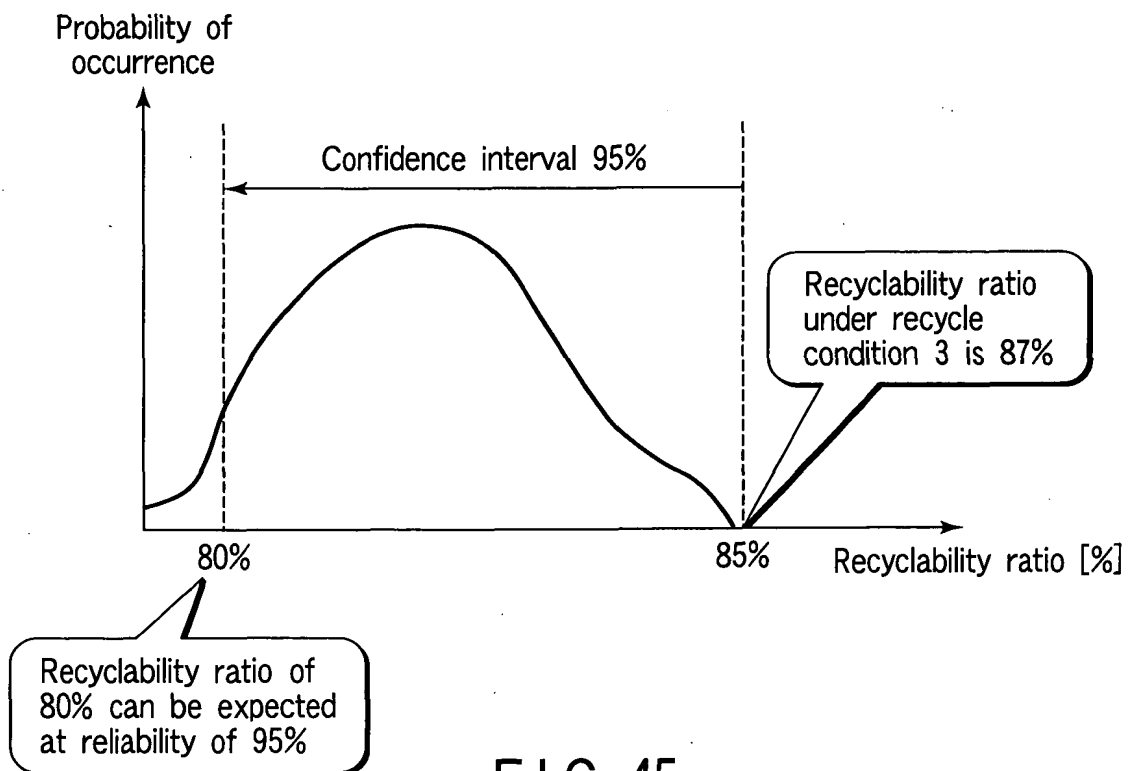


FIG. 45

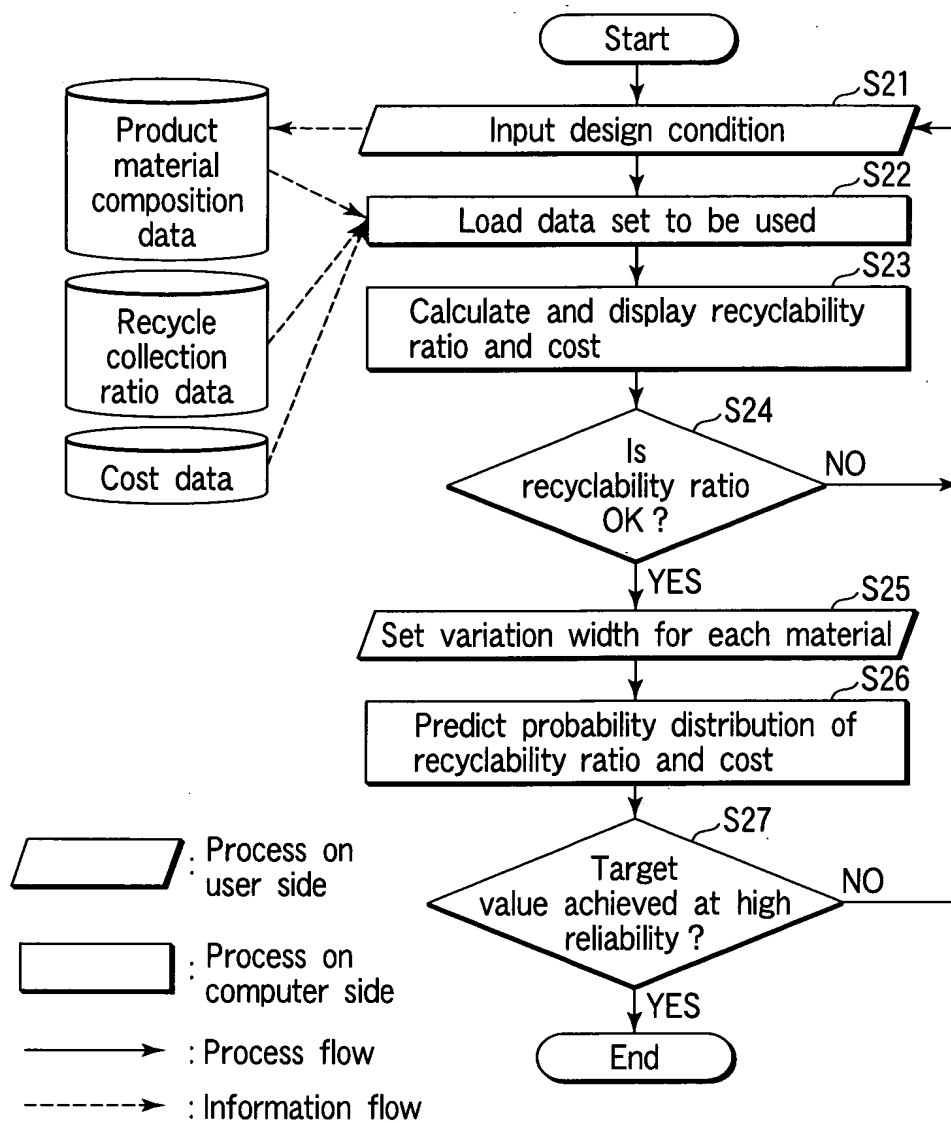


FIG. 46

Material name	Mass [g]	Recycle collection ratio [%]	Average collection unit price [yen/kg]	Average material unit price [yen/kg]
Steel	709	100%	-7	88
Copper alloy	31	100%	-125	458
Aluminum alloy	43	100%	-150	543
Other metals	4	0%	0	723
	0			
Epoxy resin	32	0%	35	340
Polyethylene	0	100%	42	397
Polystyrene	0	100%	50	147
Forming polystyrene	0	0%	78	197
AS resin	0	100%	27	279
ABS resin	79	100%	23	217
Polypropylene	424	100%	70	284
Vinyl chloride resin	20	100%	25	141
Polycarbonate	0	100%	25	131
Other resin products	3	0%	35	458
Rubber	1	0%	0	370
Glass	0	100%	-10	299
Corrugated fiberboard	0	0%	0	57
Paper	0	0%	0	137
Conductor	138	80%	-14	1,454
Semiconductor	25	0%	0	53
Other electronic parts	10	0%	0	8,100
Others	2	0%	0	

Total 1520

Intermediate process unit price [yen/kg]	27
Transport unit price [yen/kg]	46
Landfill unit price [yen/kg]	30

FIG. 47

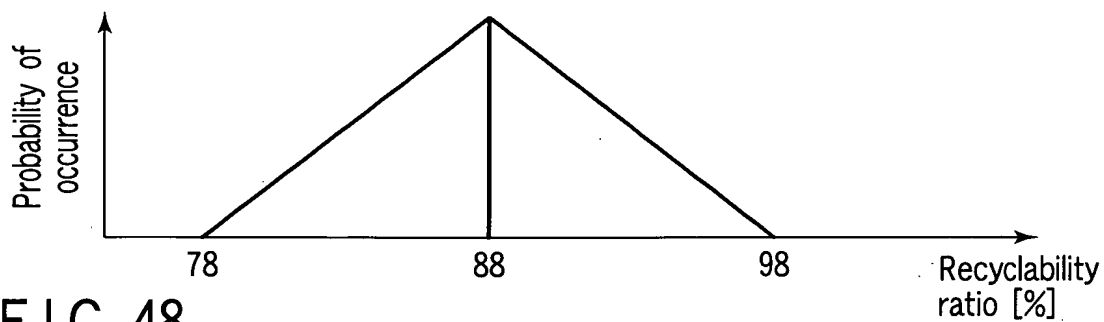


FIG. 48

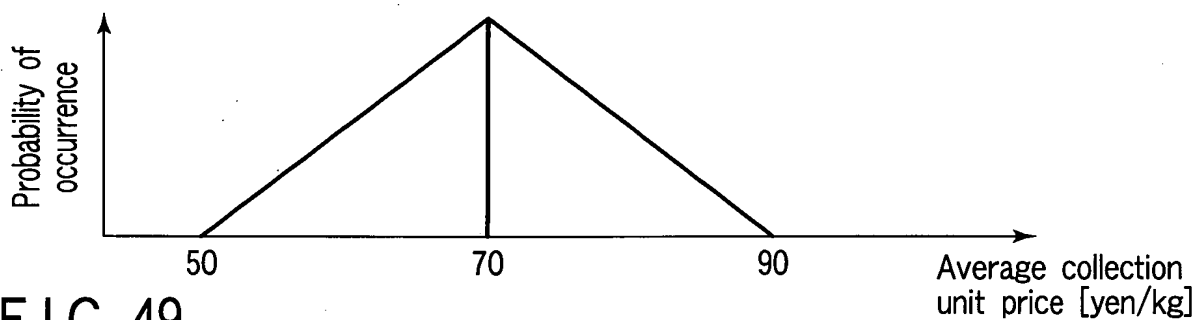


FIG. 49

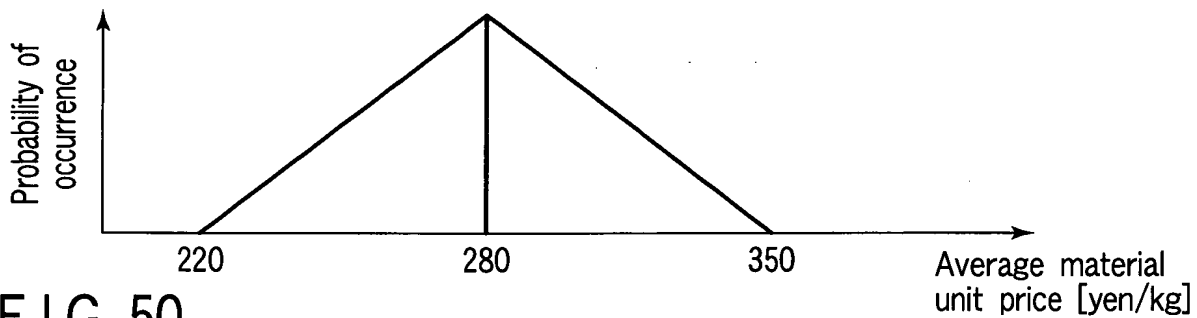


FIG. 50

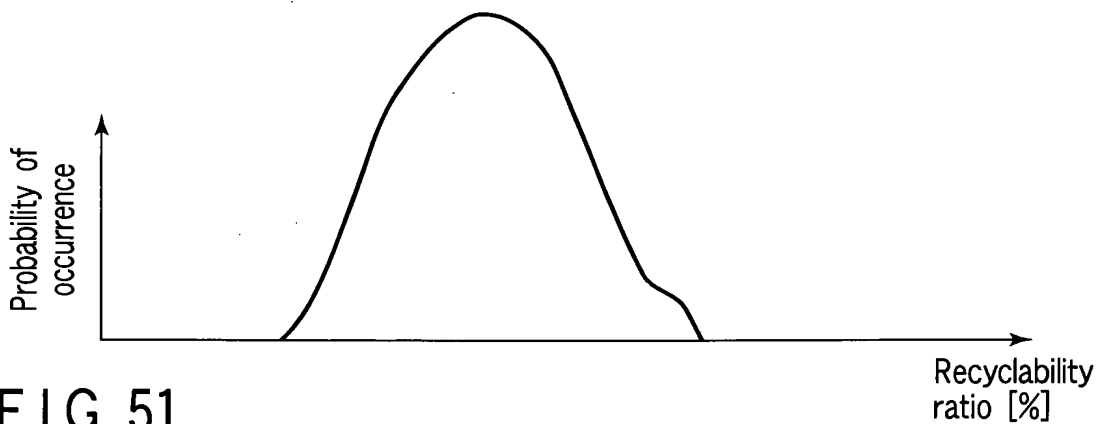


FIG. 51

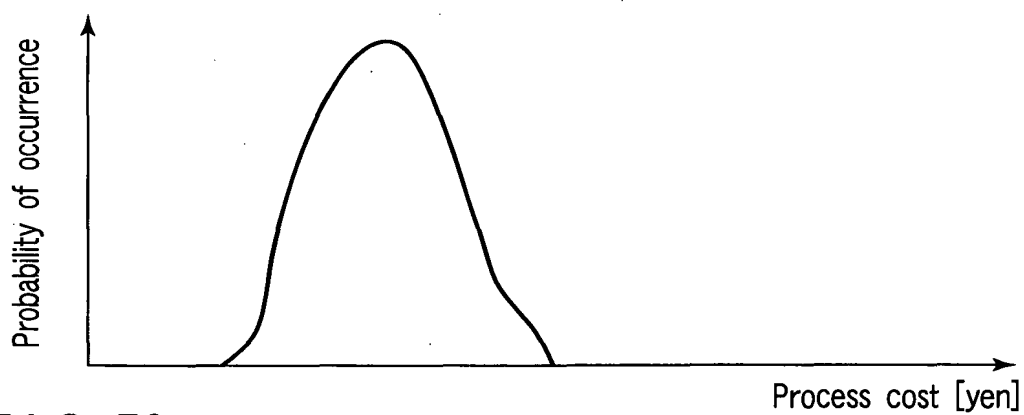


FIG. 52

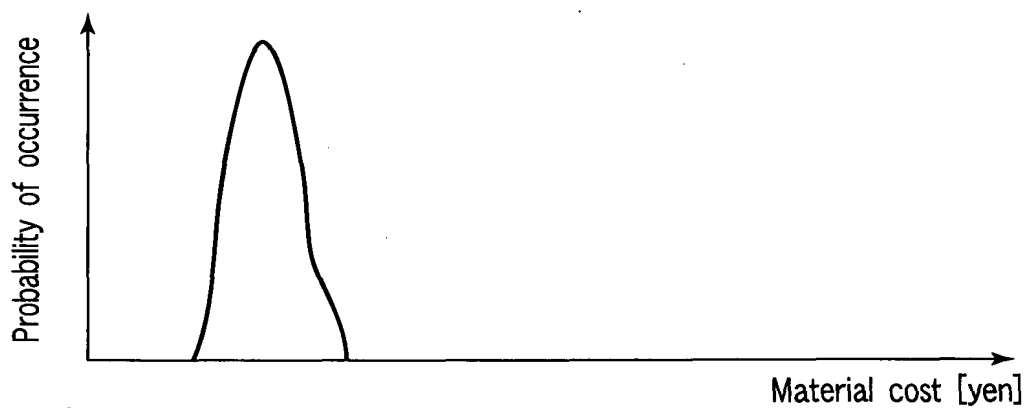


FIG. 53

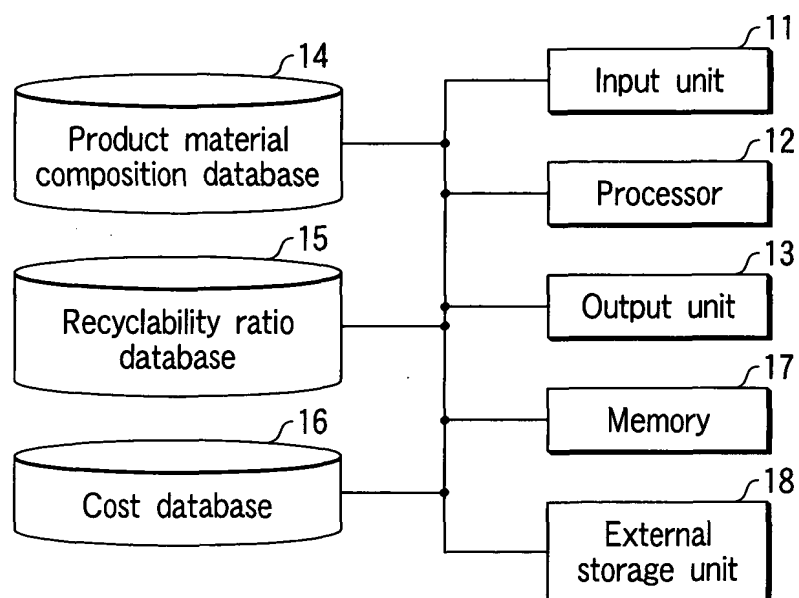


FIG. 54